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ABSTRACT

This study was designed to explore the relationship of lateral dominance to divergent cognitive thought. According to the screening results of the Harris Tests of Lateral Dominance, 36 subjects ranging from 9-12 years were divided equally into three groups of left, right, and mixed lateral dominance. In order to measure divergent cognitive thought, the Torrance Tests of Creative Thinking, Verbal Tests, Form A and Figural Tests, Form A were administered and scores reported in terms of seven subscores of both verbal and figural fluency, flexibility and originality, and scores for figural elaboration only. A two-way analysis of variance procedure reported a significant difference existed between the lateral dominance of the individuals with regard to their mean scores on the Torrance Tests of Creative Thinking at the .01 level of confidence. In order to locate the exact source of variance, further investigation was necessary. A one-way analysis of variance of the main effects was performed and results indicated that a significant difference existed within the two categories of verbal fluency and figural elaboration at the .05 level. That is, the group demonstrating left lateral dominance performed significantly better on those two subscores. (Author/MS)

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The Relationship Between Lateral Dominance and Divergent Cognitive Thought

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Paper presented at Annual Meeting of Eastern Psychological Association, April, 1976

The development of lateral dominance is part of a child's general process of psychobiological maturation. The perferred use of one side of the body as compared to the other emerges from an infant's undifferentiated movement pattern into a consistent preference for the use of one eye, hand, and foot over the other at about the age of five years.

Neurologically, the process of establishing lateral dominance is thought to be related to the functional asymmetry of the brain. For while the human brain appears to be bilaterally symmetrical, the two hemispheres differ in both structure and function. In addition to this differentiation, a further distinction is made between the two hemispheres when, as part of the maturational process, one hemisphere establishes dominance over comparable areas in the other. In human beings the dominant side of the brain is the side contralateral to the preferred hand.

Numerous studies have demonstrated that, regardless of lateral preference, the left side of the brain is largely dominant for language. In a verbally sophisticated civilization it would seem natural therefore for the left hemisphere of the brain to have become the focus of researchers' attention while the right hemisphere has gone relatively unexplored and, consequently, has remained more of a mystery.

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New evidence into the many behaviors mediated by the right hemisphere has been uncovered through the efforts of Dr. Roger Sperry, a psychobiologist at California Institute of Technology, in his work with split-brain patients. Interested in the structural as well as the functional differences between the two hemispheres, Sperry (1964) discovered that the brain could be bisected through the corpus callosum (the broad nerve fibers that connect the two hemispheres) without grossly disturbing the brain process. What did result, however, when the corpus callosum was cut, was a lack of transfer of learning and memory from one hemisphere to the other. Each hemisphere apparently retained all the reasoning centers for functioning as a whole brain independently of the other. Working with Sperry, Ronald E. Myers (see Sperry, 1964) designed special tests to assess the function of the split-brain in cats. Myers discovered that the two sides of the brain produced diametrically opposite solutions to the same experimental problem, depending upon which side of the brain was receiving the triggering stimulus. If the nerve bundles between the hemispheres were missing, the learning in one hemisphere was inaccessible to the other hemisphere.

Similar tests conducted by Michael S. Gazzaniga (see Sperry, 1964) on human patients whose hemispheres had been surgically separated in an effort to control epileptic convulsions showed results similar to those of Myers, indicating that the brain neither knew nor remembered anything

about the experiences and activities of the other hemisphere. Sperry and his colleagues concluded, therefore, that the corpus callosum functioned in interhemispheric transfer. From the results of his work, Sperry also inferred that the two brain hemispheres are for the most part separate realms of knowledge and awareness. (Sperry, 1964) Furthermore, Sperry, (1973) has noted that the right hemisphere is a "second, separate, conscious system that is definitely human in nature." The speechless and illiterate right hemisphere is now believed to perceive, feel, and think in ways all its own. Sperry (see Pines, 1973) demonstrated that the right hemisphere is superior in tasks of spatial perception, musical talent, poetic and imaginative aspects of man's behavior, while the left hemisphere is superior for sequential, verbal, analytic activities.

Guilford's distinctions between "convergent" and "divergent" thought appear to fit the contrasting functional thinking patterns between the left and right hemispheres of the brain. Based upon these findings, I hypothesized that the right hemisphere of the brain appears to control what might be called the "creative" aspects of man's intellectual processes, or using Guilford's terminology, divergent cognitive thought.

To continue for a moment with this discussion, let me refresh your memories on what could likely be a common experience for most of us. For those of you who attended last year's meeting (of the Eastern

Psychological Association) and heard Brenda Milner's Invited Address entitled "Specialization and Interaction of the Cerebral Hemispheres", you will remember her discussion of her early work in 1952 describing lesions of the left temporal lobe being associated with verbal learning deficits while right temporal lesions caused no such verbal disorders but affected the memory for places, faces, and, in short, memory for nonverbal patterns. Milner concluded that most activities rely upon the interaction between the two sides of the brain except for highly specialized tasks.

Maya Pines, in her book The Brain Changes (1973), states that dominance for speech, along with dominance for "sequential, verbal, analytic, computerlike activities" are centered in the left hemisphere. To the right hemisphere she assigns dominance for the nonverbal "tasks of synthesis, spatial perception, and music." Perhaps then, the connection lies within the right hemisphere, with its dominance for the nonverbal behaviors that typically are associated with creative thinking. When Einstein was asked how he arrived at some of his most original ideas, he explained that he rarely thought in words at all. His concepts appeared first through "physical entities" and these elements were "of visual and some of muscular type." Said Einstein of his creative work in physics: "Convential words or other signs have to be sought for laboriously only in a secondary stage, when the mentioned associative

play is sufficiently established and can be reproduced at will." (see Pine, 1973) Perhaps Einstein's description of the birth of his creative efforts gives a clue to the function of the right cerebral hemisphere in the process of divergent cognitive thought.

Participants

The children selected for the study were from a suburban middle school which consisted of fourth, fifth, and sixth level elementary school children. The organizational structure of the middle school is noteworthy, for the school is an open space facility in its third year of operation. The school population is of heterogenous ethnic and socioeconomic backgrounds.

The participants were thirty-six children of both sexes whose chronological ages ranged from nine to twelve years old. Based upon the screening results of the Harris Test of Lateral Dominance, I assigned thirty-six pupils to one of three counterbalanced groups of twelve representing left, right and mixed lateral dominance. Initially, I administered selected portions of the Harris Tests of Lateral Dominance on an individual basis to students designated as left-handed by their teachers. From these results, the first twelve students who demonstrated complete left lateral dominance were assigned to Group A. This procedure was followed because the expected frequency of left lateral dominance within the population is less than 4 percent and the number of left lateral dominant children available within the school would dictate the size of each of three groups used for the study.

Once the socioeconomic and ethnic characteristics of Group A were established, candidates for Group B and later Group C were screened by use of the Harris Test of Lateral Dominance in order to form a group of twelve right lateral dominant and a group of twelve mixed lateral dominant participants, respectively, whose personal characteristics were counterbalanced with Group A. As a result, Group A was composed of twelve children demonstrating left lateral dominance, Group B was composed of twelve children demonstrating right lateral dominance, and Group C was composed of twelve children demonstrating mixed lateral dominance.

Procedure

Once the membership of the three groups was established, I administered the Torrance Tests of Creative Thinking, Verbal Tests, Form A and Figural Tests, Form A to all thirty-six participants as a group. The results of the Torrance Tests of Creative Thinking yielded scores that were designed to measure four aspects of creative thinking: fluency, flexibility, originality, and elaboration. In the actual scoring process, I adhered very closely to the detailed instructions for the scoring criteria stated in the manuel in order to maintain objectivity. The scores were reported in terms of seven subscores of both verbal and figural fluency, flexibility, and originality, with a score for figural elaboration only. The mean scores for each group (see Table I) were statistically analyzed by the use of the two-way analysis of variance technique. The final step in the statistical analysis was to utilize

the one-way analysis of main effects in order to locate the exact source of variance.

Results

The statistical analysis by means of the two-way analysis of variance procedure performed on the collected data produced three conclusions:

1. A significant difference existed between the lateral dominance of the individuals with regard to their scores on the Torrance Tests of Creative Thinking at the .01 level of confidence.

2. A significant difference existed between the categories of measurement of fluency, flexibility, originality and elaboration on both the verbal and figural mean scores on the Torrance Tests of Creative Thinking at the .01 level of confidence.

3. No significant difference existed among the interaction of lateral dominance and the categories of measurement on the Torrance Tests of Creative Thinking scores at the .05 level of confidence.

The above results enable the investigator to reject the null hypothesis. That is, a significant difference existed between the three groups of elementary school children divided according to left, right, and mixed lateral dominance and their scores on the Torrance Tests of Creative Thinking.

Further investigation became necessary, however, in order to locate the exact source of variance among the three groups of left, right, and mixed lateral dominance on the seven categories of measurement on the Torrance Tests of Creative Thinking. The one-way analysis of variance of main effects was applied since no

significant interaction was present.

The results of this procedure (See Table II) revealed that a significant difference existed within the two categories of verbal originality and figural elaboration at the .05 confidence level. The results demonstrate that the subcomponents of divergent cognitive thought labeled verbal originality and figural elaboration are significantly related to lateral dominance of the groups under investigation. That is, the group demonstrating left lateral dominance performed significantly better on the two categories of verbal originality and figural elaboration. No significant difference was found to exist, however, among the other five categories of measurement. I concluded that the scores of the group demonstrating left lateral dominance had a positive relationship to the measures of originality and figural elaboration.

These results lend support to my original assumption that left lateral dominance had a positive relationship to divergent cognitive thought. Specifically, the data show that the left laterally dominant group demonstrated more verbal originality on the Torrance Tests of Creative Thinking. According to the manual, this score represents the subject's ability to produce ideas that deviate from the obvious commonplace, banal, or established. This score is measured by the sum of credits where routine responses were counted zero, less common responses scored one and responses too infrequent to be included in the manual given a credit of two. On this basis, the left laterally dominant group demonstrated significantly more

originality. In addition, the group of left laterally dominant individuals scored significantly higher in the assessment of figural elaboration, a measurement reflecting the ability to develop, embroider, embellish, carry out, or otherwise elaborate ideas.

Discussion

It appears that this study indicates some degree of relationship between the functions of the right cerebral hemisphere and the process of divergent cognitive thought. The right cerebral hemispheric functions manifest themselves in the individual's ability to produce ideas that deviate from the obvious or established as well as the ability to elaborate on these ideas. Thus the findings suggest evidence of the specialization of the right cerebral hemisphere in the ability to produce unique or statistically different responses.

While the distinction between the types of thought production of the right and left cerebral hemispheres may not apply to other generalized behaviors, but rather may be specific to certain types of tasks, a more salient implications appears to emerge from the data collected. The findings appear to indicate a differentiation in the cognitive mode of approach to a specific stimulus or situation in the right cerebral dominant individual as compared to the left cerebral dominant individual. The right versus le' dominance may confer upon man different functional capabilities which facilitate different methods of problem-solving behavior for different individuals.

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THE RELATIONSHIP BETWEEN LATERAL DOMINANCE AND DIVERGENT COGNITIVE THOUGHT

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TABLE I

SUMMARY OF MEAN SCORES
ON THE TORRANCE TESTS OF CREATIVE THINKING

	VERBAL TESTS			FIGURAL TESTS				TOTAL
	Fluency	Flexibility	Originality	Fluency	Flexibility	Originality	Elaboration	
Group A (Left)	84.75	32.75	69.33	24.66	19.66	37.58	86.16	50.70
Group B (Right)	74.16	29.33	36.41	23.08	16.25	26.50	51.33	36.72
Group C (Mixed)	78.00	30.16	38.83	22.33	15.58	31.16	50.25	38.04

TABLE II

ONE-WAY ANALYSIS OF
MAIN EFFECTS

Test Category	Source of Variance	Sum of Squares	Degrees of Freedom	Mean Square	F Ratio
Verbal Fluency	Between	672.04	1	672.0384	0.2563
	Within	57681.92	22	2621.9054	
Verbal Flexibility	Between	70.04	1	70.04	0.56
	Within	2716.92	22	123.49	
Verbal Originality	Between	5859.37	1	5859.37	5.499*
	Within	23441.59	22	1065.5268	
Figural Fluency	Between	15.04	1	15.04	0.1116
	Within	2963.587	22	134.7085	
Figural Flexibility	Between	70.04	1	70.04	1.412
	Within	1020.92	22	49.587	
Figural Originality	Between	737.04	1	737.04	3.32
	Within	4877.92	22	221.72	
Figural Elaboration	Between	7280.16	1	7280.16	4.7758*
	Within	33536.34	22	1524.379	

*p < .05